

ment channel comprises a single fluid inlet and outlet. Device 70 comprises main electrophoretic flow path 71 in intersecting relationship with secondary electrophoretic flow path 73. Upstream from the intersection 82 along secondary electrophoretic flow path 73 is enrichment channel 72. In using this embodiment, sample is introduced through syringe interface 80 into enrichment channel 72, whereby the analyte comprising fraction of the sample is reversibly bound to the material present in the enrichment channel. An electric field is then applied between electrodes 81 and 79 which moves the non-reversibly bound or waste fraction of the sample out of the enrichment channel 72, along secondary electrophoretic flow path 73, past intersection 82, and out discharge outlet 84 into waste reservoir 78. An elution buffer is then introduced into enrichment channel 72 through syringe interface 80 and an electric field applied between electrodes 81 and 79, causing elution buffer to flow through enrichment channel 72 into secondary flow electrophoretic flow path 73, carrying analyte along with it. When analyte reaches intersection 82, the electric field between electrodes 79 and 81 is replaced by an electric field between electrodes 76 and 77, which causes analyte to move along main electrophoretic flow path 71 and towards reservoir 74 through detection region 99.

The device shown diagrammatically in FIG. 6 comprises an enrichment channel having an electrophoretic enrichment means, instead of the chromatographic enrichment means of the devices of FIGS. 1 to 5. In device 90, sample is introduced into reservoir 96 and an electric field is applied between electrodes 87 and 88, causing the sample to migrate towards reservoir 98. As the sample migrates towards reservoir 98 it enters stacking gel 93 having a relatively large pore size and travels towards secondary gel 92 of relatively fine pore size. At interface 94, the sample components are compressed into a narrow band. At this point, the electric field between electrodes 87 and 88 is replaced by an electric field between electrodes 89 and 90, which causes the narrow band of sample components at interface 93 to migrate into main electrophoretic flowpath 95, past detection region 91 and towards reservoir 85. In device 90, instead of the stacking gel configuration, one could provide for a molecular size membrane at the region of interface 93, which can provide for selective passage of sample components below a threshold mass and retention at the membrane surface of components in excess of the threshold mass. In yet another modification of the device shown in FIG. 6, present at the location of interface 93 could be an electrode by which an appropriate electric potential could be applied to maintain a sample component of interest in the region of 93, thereby providing for component concentration in the region of 93. For example, for an anionic analyte of interest, upon introduction of sample into reservoir 96 and application of an electric field between 93 and 87, in which 93 is the positive electrode and 87 the ground, the anionic will migrate towards and concentrate in the region of 93. After the analyte has concentrated in the region of electrode 93, an electric field can then be applied between 89 and 90 causing the anionic analyte to migrate towards reservoir 85.

FIG. 7 provides a top diagrammatic view of a disk shaped embodiment of the subject device, as opposed to the credit card shaped embodiments of FIGS. 3 to 6. In device 100, sample is first introduced into enrichment channel 102. An electric field is then applied between electrodes 108 and 109, moving elution buffer 103 through enrichment channel 102, whereby analyte retained in the enrichment channel 102 is released and carried with the elution buffer to intersection 114. The electric field between 108 and 109 is then replaced

with an electric field between 110 and 111, causing analyte to move from intersection 114 along main electrophoretic flow path 112, past detection region 113 and towards reservoir 107.

The subject devices may be used in a variety of electrophoretic applications, where one or more electric fields are applied to a medium to move entities through the medium. Representative electrophoretic applications include separation applications, preparation applications, sequencing applications, synthesis applications, analyte identification applications, including clinical, environmental, quality control applications, and the like. Thus, depending on the particular application a variety of different fluid samples may be introduced into the subject device, where representative samples include bodily fluids, environmental fluid samples, e.g. water and the like, or other fluid samples in which the identification and/or isolation of a particular analyte is desired. Depending on the particular application, a variety of different analytes may be of interest, including drugs, toxins, naturally occurring compounds such as peptides and nucleic acids, proteins, glycoproteins, organic and inorganic ions, steroids, and the like. Of particular interest is the use of the subject devices in clinical applications, where the samples that may be analyzed include blood, urine, plasma, cerebrospinal fluid, tears, nasal or ear discharge, tissue lysate, saliva, ocular scrapings, fine needle biopsies, and the like, where the sample may or may not need to be pretreated, i.e. combined with a solvent to decrease viscosity, decrease ionic strength, or increase solubility or buffer to a specific pH, and the like, prior to introduction into the device. For clinical applications, analytes of interest include anions, cations, small organic molecules including metabolites of drugs or xenobiotics, peptides, proteins, glycoproteins, oligosaccharides, oligonucleotides, DNA, RNA, lipids, steroids, and cholesterol, and the like.

The following examples are offered by way of illustration and not by way of limitation.

## EXPERIMENTAL

### Example 1

#### High Efficiency Separation of Organic Analytes in an Aqueous Sample

A card as shown in FIG. 4 is used in the separation of organic analytes in an aqueous sample as follows in conjunction with a device that provides for the application of appropriate electric fields through introduction of electrodes into each reservoir of the card and provides for a means of detecting analyte as it passes through detection region 65. In Card 50, the enrichment channel 62 comprises porous beads coated with a C-18 phase, while the reservoirs and channels, except for the waste reservoir, comprise 20 millimolar borate buffer. A 100  $\mu$ l aqueous sample is injected into enrichment channel 62 through interface 66. Substantially all of the organic analyte in the sample reversibly binds to the C18 coated porous beads, while the remaining sample components flow out of enrichment channel 62 into waste reservoir 63. 10  $\mu$ l of an elution buffer (90% methanol/ 10% 20 millimolar borate buffer pH 8.3) are then introduced into the enrichment channel 62 through interface 66, whereby the reversibly bound organic analyte becomes free in the elution buffer. Because of the small volume of elution buffer employed, the concentration of analyte in the volume of elution buffer as compared to the analyte concentration in the original sample is increased 100 to 1000 times. The seals over reservoirs 57 and 56 are then removed and an electric